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SECTION 2: WATERBODY DESCRIPTION AND PROBLEM SPECIFICATION

2.1 BRIEF SUMMARY OF CHESAPEAKE BAY AND WATERSHED

This section provides a description of the Chesapeake Bay and its watershed. *EPA solicits comments on whether the information in this TSD is helpful to the jurisdictions when they conduct their individual UAAS during their nutrient and sediment related water quality standards development process, and on what additional information would also be valuable to this process.*

2.1.1 Waterbody

The Chesapeake Bay is one of this country's most valuable natural treasures. Even after centuries of intensive use, the Bay remains a highly productive natural resource. It supplies millions of pounds of seafood, functions as a major hub for shipping and commerce, provides natural habitat for wildlife and offers a variety of recreational opportunities for residents and visitors. The Bay supports 348 species of finfish, 173 species of shellfish and more than 2,700 plant species. It is home to 29 species of waterfowl and is a major resting ground along the Atlantic Migratory Bird Flyway. Every year, 1 million waterfowl winter in the Bay's basin.

The Bay proper is approximately 200 miles long, stretching from Havre de Grace, Maryland, to Norfolk, Virginia. It varies in width from about 3.4 miles near Aberdeen, Maryland, to 35 miles at its widest point, near the mouth of the Potomac River. Including its tidal tributaries, the Bay has approximately 11,684 miles of shoreline.

On average, the Chesapeake holds more than 15 trillion gallons of water. Although the Bay's length and width are dramatic, the average depth is only about 21 feet. The Bay is shaped like a shallow tray, except for a few deep troughs believed to be remnants of the ancient Susquehanna River. The troughs, which in some areas are maintained by dredging, form a deep channel along much of the length of the Bay. This channel allows passage of large commercial vessels. Because it is so shallow, the Chesapeake is far more sensitive to temperature fluctuations and wind than the open ocean.

The Chesapeake Bay is an estuary, where fresh and salt water mix. About half of the water volume in the Bay is salt water from the Atlantic Ocean. The other half drains into the Bay from an enormous 64,000 square mile drainage basin or watershed. Ninety percent of this fresh water is delivered from five major rivers: the Susquehanna (which is responsible for about 50% just by itself), the Potomac, the James, the Rappahannock and the York.

The distribution and stability of an estuarine ecosystem, such as the Chesapeake Bay, depends on three important physical characteristics of the water: salinity, temperature and circulation. Salinity is a key factor influencing the physical make-up of the Bay. Seawater from the Atlantic Ocean enters the mouth of the Bay. Salinity is highest at that point and gradually decreases as one moves north. Saltier water is more dense than fresh water, therefore, salinity increases with depth and freshwater tends to remain at the surface. Salinity levels within the Chesapeake vary widely, both seasonally and from year to year, depending on the volume of freshwater flowing into the Bay.

Temperature dramatically changes the rate of chemical and biological reactions within the water. Because the Bay is so shallow, its capacity to store heat over time is relatively small. As a result, water temperature fluctuates throughout the year, ranging from 34 to 84° Fahrenheit. These changes in water temperature influence when plants and animals feed, reproduce, move locally, or migrate. The temperature profile of the Bay is fairly predictable. During spring and summer, surface and shallow waters are warmer than deeper waters with the coldest water found at the bottom. Often turbulence of the water helps to break down this layering.

Just as circulation moves much-needed blood throughout the human body, circulation of water transports plankton, fish eggs, shellfish larvae, sediments, DO, minerals and nutrients throughout the Bay. Circulation is driven primarily by the movements of freshwater from the north and saltwater from the south. Circulation causes nutrients and sediments to be mixed and resuspended. This mixing creates a zone of maximum turbidity that, due to the amount of available nutrients, is often used as a nursery area for fish and other organisms.

Together, salinity, temperature and circulation dictate the physical characteristics of water. The warmer, lighter freshwater flows seaward over a layer of saltier and denser water flowing upstream. The opposing movement of these two flows forms saltwater fronts or gradients that move up and down the Bay in response to the input of freshwater. These fronts are characterized by intensive mixing. A layer separating water of different densities, known as a pycnocline, is formed. This stratification varies within any season depending on rainfall. Stratification is usually highest in the spring as the amount of freshwater in the Bay increases due to melting snow and frequent rain. Stratification is maintained throughout summer due to the warming of surface waters.

In autumn, fresher surface waters cool faster than deeper waters and sink. Vertical mixing of the two water layers occurs rapidly, usually overnight. This mixing moves nutrients up from the bottom, making them available to phytoplankton and other organisms inhabiting upper water levels. This turnover also distributes much-needed DO to deeper waters. During the winter, water temperature and salinity are relatively constant from surface to bottom.

The chemical composition of the water also helps determine the distribution and abundance of plant and animal life within the Bay. The waters of the Chesapeake contain organic and inorganic materials, including dissolved gases, nutrients, inorganic salts, trace elements, heavy metals and potentially toxic chemicals.

DO is essential for most animals inhabiting the Bay. The amount of available oxygen is affected by salinity and temperature. Cold water can hold more DO than warmer water, and freshwater holds more than saline water. Thus, concentrations of DO vary, in part, with both location and time. Oxygen is transferred from the atmosphere into surface waters by diffusion and the aerating action of the wind. It also is added as a byproduct of photosynthesis. Floating and rooted aquatic plants and phytoplankton release oxygen when photosynthesizing. Since photosynthesis requires light, production of oxygen by aquatic plants is limited to shallow water areas, usually less than six feet deep. Surface water is nearly saturated with oxygen most of the year, while deep bottom waters range from saturated to anoxic (no oxygen present).

During the winter, respiration levels of organisms are relatively low. Vertical mixing is good, and there is little salinity or temperature stratification. As a result, DO is plentiful throughout the water column. During the spring and summer, increased levels of animal and microbial respiration and greater stratification may reduce vertical mixing, resulting in low levels of DO in deep water. In fact, deep parts of some tributaries like the Patuxent, Potomac and Rappahannock rivers and deep waters of the Bay's mainstem can become anoxic in summer. In the autumn when surface waters cool, vertical mixing occurs and deep waters are re-oxygenated.

2.1.2 Watershed

The Chesapeake Bay receives about half its water volume from the Atlantic Ocean. The rest drains into the Bay from an enormous 64,000 square-mile drainage basin or watershed. The watershed includes parts of New York, Pennsylvania, West Virginia, Delaware, Maryland and Virginia and the entire District of Columbia. Threading through the Bay watershed are several "subwatersheds," smaller systems that drain into the streams and rivers that flow into the Chesapeake.

Although the Bay lies totally within the Atlantic Coastal Plain, the watershed includes parts of the Piedmont Province and the Appalachian Province. The waters that flow into the Bay have different chemical identities, depending on the geology of the place where the waters originate. In turn, the nature of the Bay itself depends on the characteristics and relative volumes of these contributing waters.

The Atlantic Coastal Plain is a flat, low land area with a maximum elevation of about 300 feet above sea level. It is supported by a bed of crystalline rock, covered with southeasterly dipping wedge-shaped layers of relatively unconsolidated sand, clay and gravel. Water passing through this loosely compacted mixture dissolves many of the minerals. The most soluble elements are iron, calcium and magnesium. The Coastal Plain extends from the edge of the continental shelf, to the east, to a fall line that ranges from 15 to 90 miles west of the Bay. This fall line forms the boundary between the Piedmont Plateau and the Coastal Plain. Waterfalls and rapids clearly mark this line, which is close to Interstate 95. Here, the elevation rises to 1,100 feet. Cities such as Fredericksburg and Richmond in Virginia, Baltimore in Maryland, and the District of Columbia developed along the fall line taking advantage of the potential water power generated by the falls. Since colonial ships could not sail past the fall line, cargo would be transferred to canals or overland shipping. Cities along the fall line became important areas for commerce.

The Piedmont Plateau ranges from the fall line in the east to the Appalachian Mountains in the west. This area is divided into two geologically distinct regions by Parrs Ridge, which traverses Carroll, Howard and Montgomery counties in Maryland and adjacent counties in Pennsylvania.

Several types of dense crystalline rock, including slates, schists, marble and granite, compose the eastern side. This results in a very diverse topography. Rocks of the Piedmont tend to be impermeable, and water from the eastern side is low in the calcium and magnesium salts. The western side of the Piedmont consists of sandstones, shales and siltstones, underlain by limestone. This limestone bedrock contributes calcium and magnesium to its water, making it hard. Waters from the western side of Parrs Ridge flow into the Potomac River, one of the Bay's largest tributaries.

The Appalachian Province lies in the western and northern parts of the watershed. Sandstone, siltstone, shale and limestone form the bedrock. These areas, characterized by mountains and valleys, are rich in coal and natural gas deposits. Water from this province flows to the Bay mainly via the Susquehanna River.

The hospitable climate, lush vegetation and natural beauty of the Chesapeake region have attracted people for thousands of years. Hunting and gathering people first came to the region about 10,000 years ago. Native Americans began cultivating crops and settling in towns throughout the area around a thousand years ago. First arriving less than 500 years ago, Europeans, and Africans first forcibly brought by them to the region in 1619, struggled to transform forests to farm fields during the colonial era between 1524 and 1775.

Since then, social, political, economic and technological developments in metallurgy, steam power, internal combustion engines, chemical engineering and, most recently, electronics, have enabled people to transform regional environments in dramatic ways. Excessive forest clearing and poor land management have increased erosion, sending tons of sediment downstream. As a result, communities that once served as important ports are now landlocked, and elsewhere, the construction of sea walls and breakwaters has interfered with the natural flow of sand, causing beaches to erode too rapidly.

The changes brought about during hundreds of years of forest clearing and urban development have resulted in the following breakdown of current land use in the watershed: 58% forest, 23% agriculture, 9% urban/suburban and 10% mixed open (the transition from agriculture to urban/suburban with low levels of development and low population densities).

Today, close to 16 million people live in the Bay watershed. **Exhibit 2-1** provides a demographic summary of this population.

Each watershed resident lives just a few minutes from one of the more than 100,000 streams, creeks and rivers that drain into the Bay. Each of these tributaries can be considered a pipeline from your community into the Bay and its rivers. Because things on land are easily washed into streams and rivers, our actions on the land ultimately affect the Bay. These activities even include the use of automobiles, fertilizers, pesticides, toilets, water and electricity.

Exhibit 2-1: Chesapeake Bay Watershed Demographics (from 1990 U.S. Census)

Race	Educational Attainment	Housing Location	Means of Sewage Disposal	Source of Water	Transportation to Work
White – 78.1% Black – 18.5% Asian – 2.3% American Indian – 0.3% Other – 1%	No High School Diploma – 23.1% High School Diploma – 47.7% Associate Degree – 5.3% Bachelor Degree – 14.4% Graduate Degree – 9.5%	Urban – 71.7% Rural – 27.4% Farm – 0.9%	Public – 74.1% Septic – 24.6% Other – 1.3%	Public – 77.6% Well – 20.8% Other – 1.6%	Drive Alone – 70.3% Carpool – 15% Public Transportation – 6.4% Bike/Walk – 4.5% Work Home – 3.2%

2.2 Water Quality Problems in the Bay

2.2.1 Indicators

Chesapeake Bay water quality problems are evidenced by the following indicators that reveal the effects of excessive amounts of nutrients and sediments in the water column.

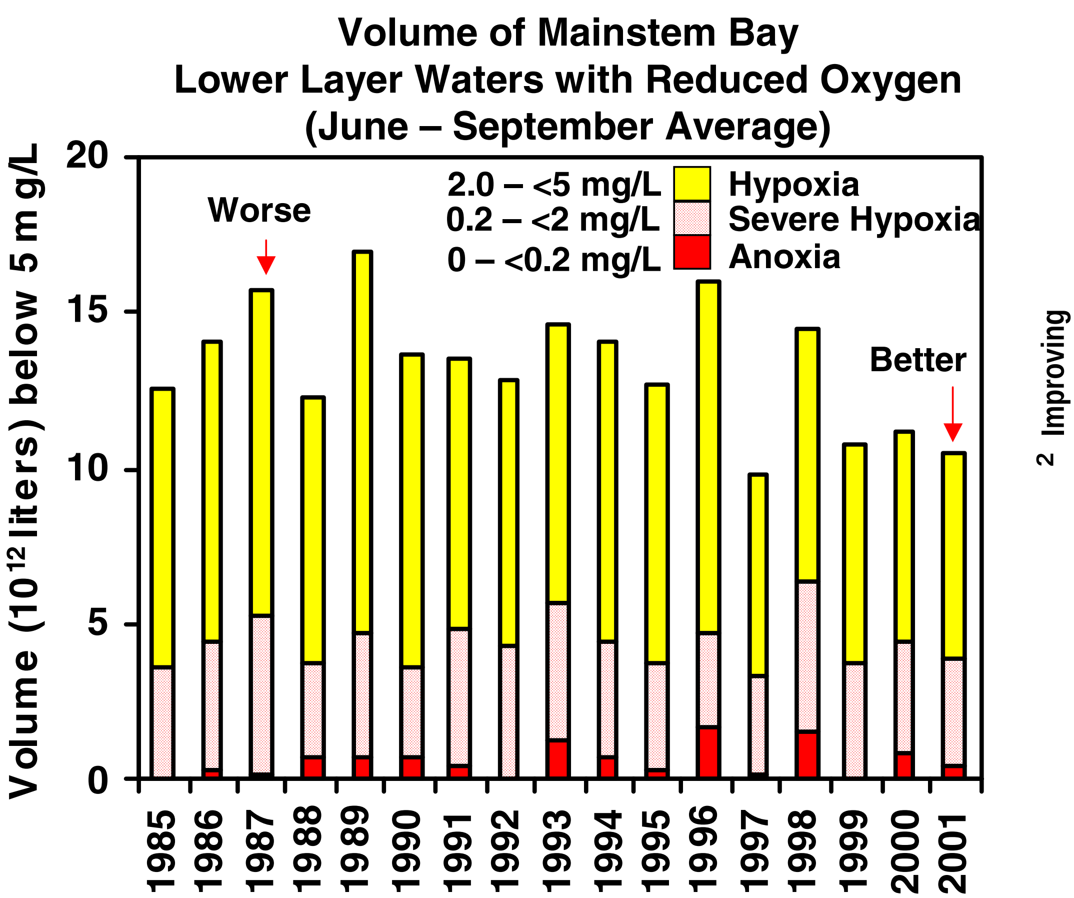


Exhibit 2-2: Mainstem Bay Summer DO Concentrations

There are recent indications of an improving trend in DO since 1985 (Data back to 1985 is shown in these indicators because that is when the Chesapeake Bay Program's fully organized data collection efforts were initiated). In 2001, half of the Bay's lower layer waters had reduced oxygen (hypoxia). Hypoxic conditions are stressful for aquatic life and sometimes lethal if severely hypoxic. If no oxygen (anoxia) is present in bottom water, nutrients tied up in sediments are released to overlying waters, fueling eutrophication.

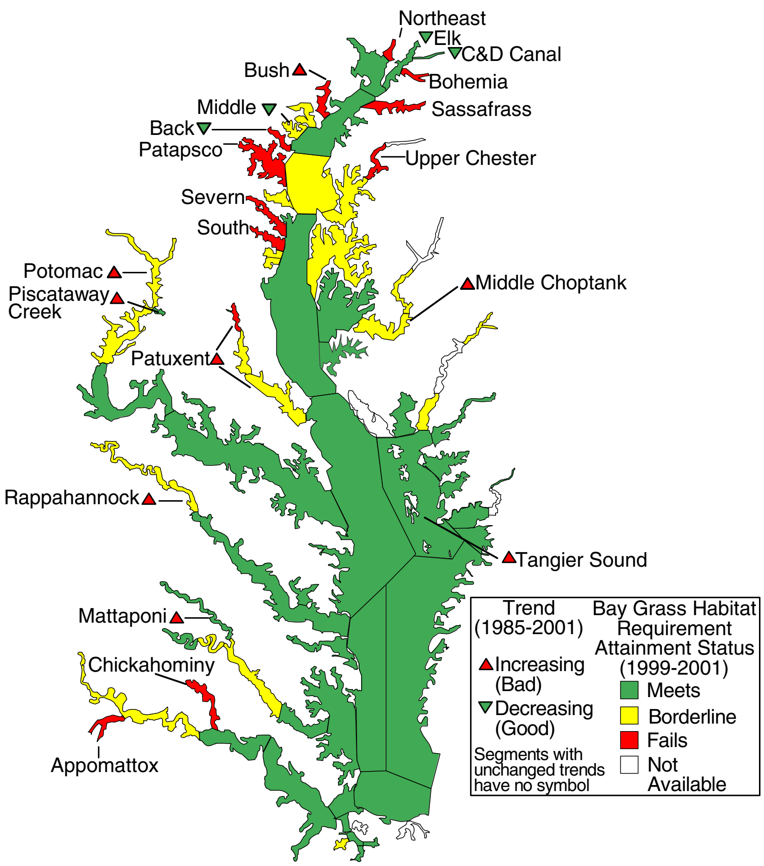


Exhibit 2-3: Chlorophyll a in the Mainstem Bay and Tidal Tributaries: Status and Trends (SAV Growing Season)

Chlorophyll is an estimate of algal biomass. Algae are important in the food chain, they are a factor in water clarity, and they are first-responders to nutrient level changes. The Elk, Middle and Back rivers, and the C&D Canal show improvements. Most areas show no significant change, although a number of tributaries and Tangier Sound show degrading trends. While most areas meet the habitat requirements for SAV, upper reaches of large tributaries and most upper Bay tributaries are borderline or failing.

Water clarity as measured by Secchi depth is degrading in many parts of the basin. While most of the mainstem Bay, larger embayments and lower regions of large tributaries meet the minimum light requirement for SAV, upper regions of the large tributaries and many minor tributaries fail. Water clarity is improving in portions of the upper Bay, Middle River and upper regions of the Chester and Choptank rivers.

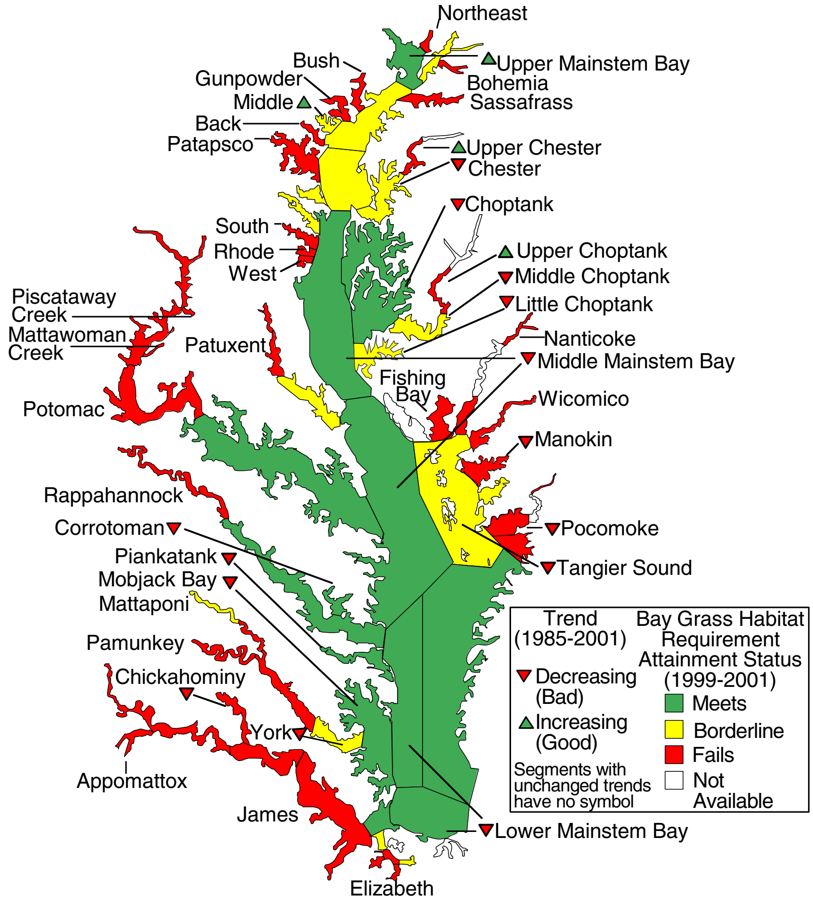


Exhibit 2-4: Secchi Depth in the Mainstem Bay and Tidal Tributaries: Status and Trends (SAV Growing Season)

2.2.2 Causes of Bay Water Quality Problems

The Chesapeake Bay, the largest estuary in the United States, is part of an extremely productive and complex ecosystem. This ecosystem consists of the Bay, its tributaries and the living resources it supports. Humans, too, are a part of this ecosystem. We are beginning to understand how our activities affect the Bay's ecology and have led to declines in Bay water quality.

Population Increase

The relentless encroachment of people threatens the ecological balance of the Bay. Population in the Bay watershed has doubled since the 1950s. Today, close to 16 million people live, work and play in the watershed. Each individual directly affects the Bay by adding waste, consuming resources and changing the character of the land, water and air that surround it. (See **Exhibit 2-5**).

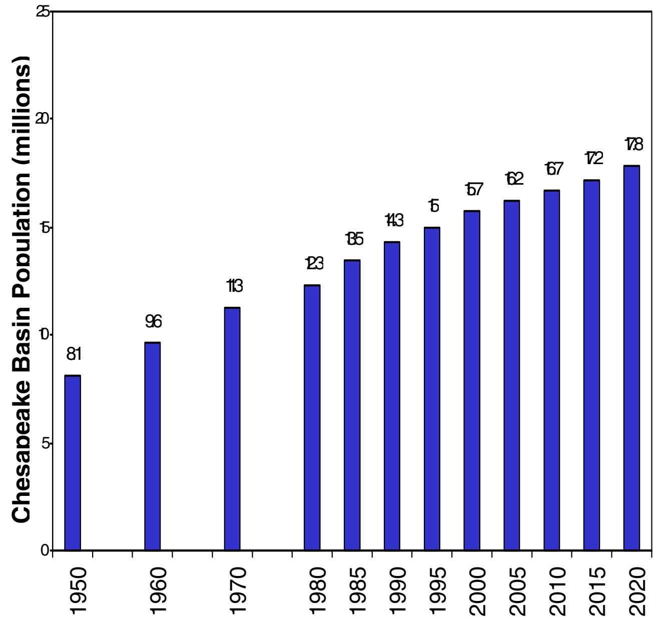


Exhibit 2-5: Chesapeake Bay Watershed Population

Loss of Habitat

Historically, habitat provided by oysters, underwater bay grasses, wetlands and forests enabled the Bay ecosystem to recycle nutrients and sediments efficiently, resulting in one of the most productive ecosystems in the world. Dramatic loss of these habitats has not only led to declines in the creatures that rely on them for food and shelter, but the loss of these habitats has reduced the ability of the ecosystem to fully utilize nutrients and sediments leading to poor water quality in the Bay.

In addition to the aquatic reef habitat they provide, oysters are voracious feeders, each capable of filtering up to 50 gallons of water per day. It is estimated that at their peak abundance, the total population of oysters in the Bay could filter an amount of water equal to all the water in the Bay in three days. Today, due to decreased abundance, it takes a year for these animals to filter the same volume of water. Oyster harvests in the Bay have declined due to overharvesting, disease, pollution and loss of oyster reef habitat. Two diseases, discovered in the 1950s and caused by the parasites MSX and Dermo, have been a major cause of the oyster's decline during recent times. (See **Exhibit 2-6**)

Underwater bay grasses are also known as SAV. Bay grasses are important because they produce oxygen, are food for a variety of animals (especially waterfowl), provide shelter and nursery areas for a variety of fish and shellfish, reduce wave action and shoreline erosion, absorb nutrients such as phosphorus and nitrogen, and trap sediments. Although SAV increased from a low point of 37,000 acres in 1984 to 85,000 acres in 2001, it has been estimated that historically, about 200,000 acres of grasses grew along the shoreline of the Bay. The Chesapeake Bay Program's interim goal is to protect and restore 114,000 acres of SAV. (See **Exhibit 2-7**)

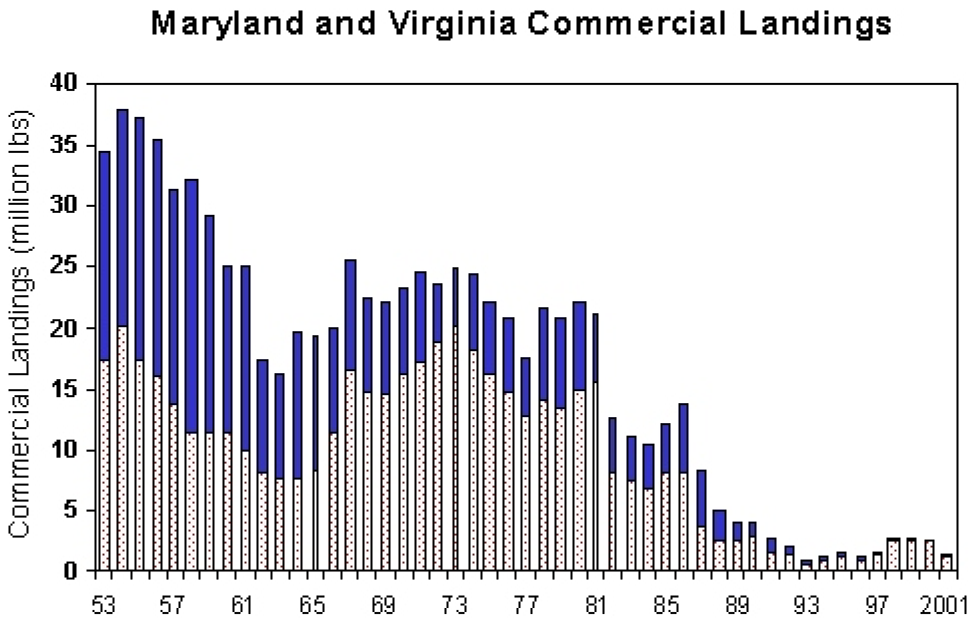
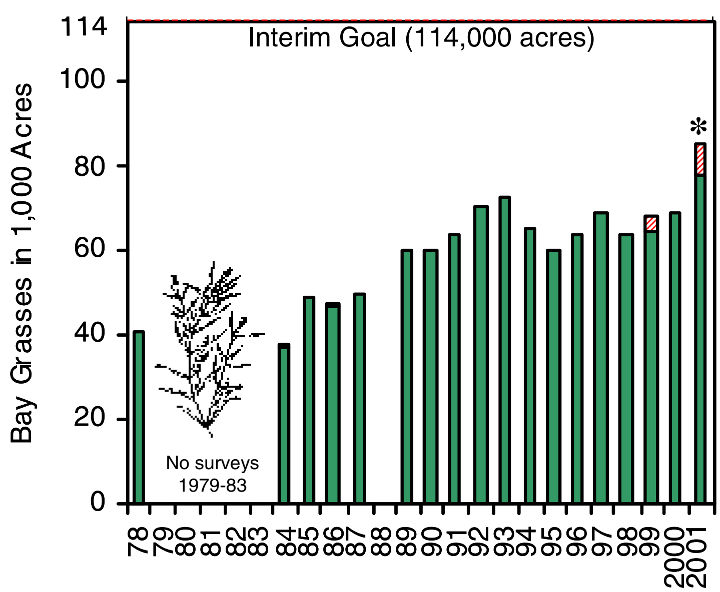


Exhibit 2-6: Trends in Shellfish: Oyster Harvest



*Hatched area of bar includes estimated additional acreage.

Exhibit 2-7: Acres of Bay Grasses

Wetlands and forests (especially those buffering streambanks and shorelines) provide critical habitat and also act as natural filters to minimize sediment loads and absorb nutrients. Approximately 1.5 million acres of wetlands remain in the Bay watershed, less than half of the wetlands that were here during colonial times. Forests that once covered 90 to 95% of the watershed now cover only 58%. (See **Exhibit 2-8**)

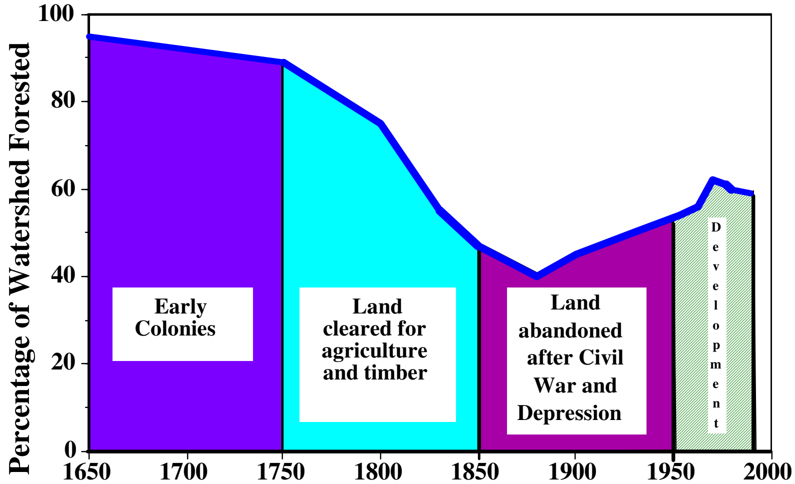


Exhibit 2-8: Chesapeake Basin Forest

Restoration, conservation and preservation of the habitat provided by oysters, underwater bay grasses, wetlands and forests is critical for restoring living resources and for improving Bay water quality.

Excess Nutrients

Nutrients are essential; they provide critical ingredients to help living things grow. However, there is a delicate balance between what is needed for organisms to thrive, and what is excessively harmful. The amount of nutrients that would naturally enter the Bay has been adversely multiplied by anthropogenic sources over the course of history. Runoff from fertilizers applied to agriculture and lawns, sewage and industrial discharges, cars emissions and power generation, are all sources that create excessive amounts of nutrient pollution delivered to the Bay. This, together with a decline in the Bay's own natural capacity to assimilate these pollutants due to loss of habitats and living resources, has created overwhelming stresses for the Bay.

Excess amounts of nitrogen and phosphorus cause rapid growth of phytoplankton, creating dense populations or blooms. These blooms become so dense that they reduce the amount of sunlight available to underwater Bay grasses. Without sufficient light, plants cannot photosynthesize and produce the food they need to survive. Algae also may grow directly on the surface of Bay grasses, blocking light. Another hazard of nutrient-enriched algal blooms comes after the algae die. As the blooms decay, oxygen is consumed via decomposition which can lead to dangerously low oxygen levels available for aquatic organisms. Thus nutrient over enrichment, ultimately leading to low DO levels in ambient waters, is a ubiquitous problem throughout the watershed.

Excess Sediments

The waters of the Chesapeake and its tributaries transport huge quantities of sediments. Although sediments are a natural part of the Bay ecosystem, accumulation of excessive amounts of sediments is undesirable. As sediments settle to the bottom of the Bay, they can smother bottom-dwelling plants and animals, such as oysters and clams. Sediments suspended in the water column cause the water to become cloudy, decreasing the light available for underwater bay grasses. Sediment related water quality problems, however, tend to be more of a localized problem.

Individual sediment particles have a large surface area, and many molecules easily adsorb or attach to them. As a result, sediments can act as chemical sinks by adsorbing nutrients and other pollutants. Thus, areas of high sediment deposition sometimes have high concentrations of nutrients which may later be released. Reducing sediment loads to the Bay is critical for restoring water quality.

2.2.3 Sources of Nutrient Loads to the Bay

When accounting for all the nutrients that enter the Bay, the two largest contributors of both nitrogen and phosphorus are non point source runoff from agriculture and point sources. Forests are a natural source of nutrients. The ocean is also a significant source of nutrients to the Bay, but is not accounted for in the any of these charts. **Exhibits 2-9** and **2-10** provide a breakdown of the nitrogen and phosphorus load to the Bay.

Atmospheric Sources

The sources of nitrogen emissions which contribute to the nitrogen deposition to the Bay and its watershed are primarily fossil fuels combustion (e.g., electric power generation, on-road vehicles, and industry) which generates nitrogen oxide emissions and agricultural activities (e.g., commercial fertilizers and animal manure) which release ammonia into the air. The air modeling that has been done with NOx emissions indicate that utilities and vehicles are the greatest contributors and that they are roughly equal to one another in their contribution.

Atmospheric nutrient pollution that falls directly on the water is displayed as a separate category and accounts for 8 percent of the total nitrogen load. Atmospheric nitrogen also falls on the land and accounts for an additional 24 percent of the total nitrogen load, but is included as part of the agriculture, forest and urban and mixed open sources in Exhibit 2-9. **Exhibit 2-11** shows the "atmospheric loads from land" component, after removal from the nonpoint source land sources (agriculture, forest, urban and mixed open).

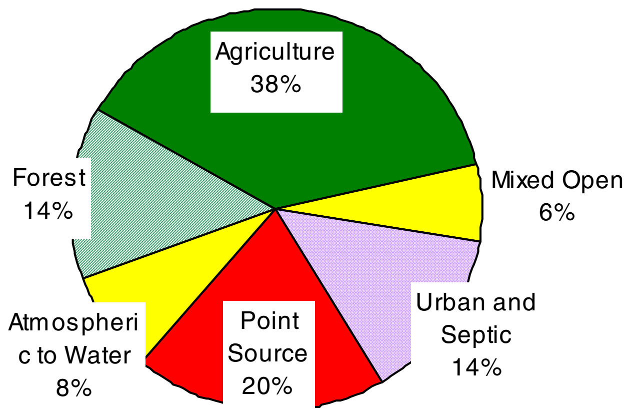


Exhibit 2-9: Sources of Nitrogen Loads to the Bay
(305 million pounds in 2000)

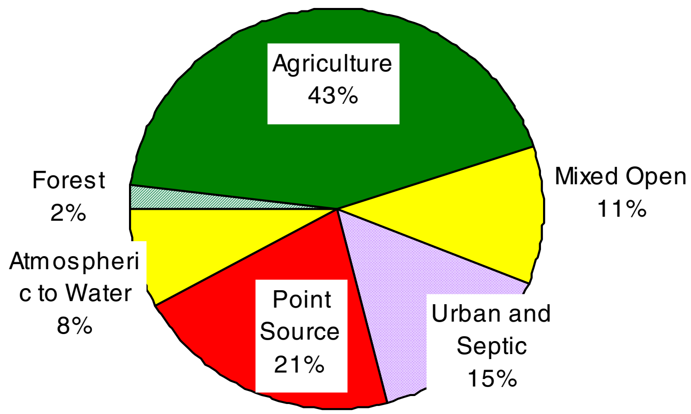


Exhibit 2-10: Sources of Phosphorus Loads to the Bay
(20.7 million pounds in 2000)

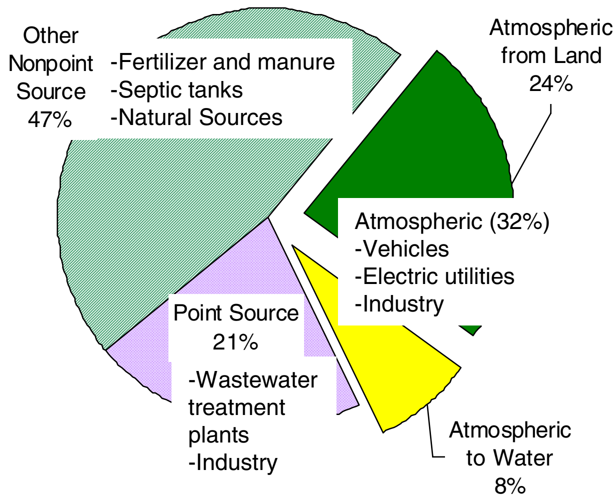


Exhibit 2-11: Sources of Nitrogen Loads to the Bay (showing total atmospheric component)

Nonpoint Sources

Storm water and groundwater carry nutrients into rivers and the Bay from a variety of nonpoint sources. Animal waste or fertilizers applied to lawns, gardens and farm fields can wash off the land into streams and rivers or seep into the ground where they can be delivered to streams via groundwater. A significant amount of nitrogen pollution is created when we drive cars and when we generate electricity by burning fossil fuels, such as coal and oil. This nitrogen, in the form of nitrogen oxide gases, falls onto the land and is delivered to the Bay via storm water and groundwater.

Septic systems leak nutrients into the groundwater since most systems currently do not incorporate technologies to remove nitrogen from the wastewater they discharge. Septic systems are a source of nitrogen to the watershed not only from the treated effluent, but from systems that are not functioning properly due to age, neglect in operation and maintenance, or improper siting and installation.

Agricultural runoff includes nutrients from chemical fertilizers and animal manure applied to land, as well as eroded soil particles and organic matter. Improper storage of animal wastes and mortality can result in additional nutrients being leaked into groundwater or carried off in rainwater. Animals pastured near streams and other water bodies also contribute nutrients to the tributaries of the Bay.

Increases in nutrient runoff from urban areas are expected to occur in the future due to increasing development of forested and agricultural lands. Nitrogen loads from septic systems are expected to increase as population increases, however, if people continue to move away from the urban/ suburban areas that are currently serviced by public sewer facilities, projected loads may be even higher. Runoff from farms is generally declining as farmers adopt nutrient management and runoff control techniques, but also because the overall amount of farmland is declining.

Point Sources

A point source is an outfall pipe associated with a point of entry, such as the end of a pipe, where nutrients enter waterways. Industrial sites and wastewater treatment plants are examples of point sources. Point sources account for 20 percent of the total load of nitrogen and phosphorus to the Bay. The Chesapeake Bay Program, working with its states and jurisdictions, assimilated a database on all of the point sources with significant contributions of nutrients to the watershed. (Sediments are not currently counted as a component of point source effluents). The point source database consists of facilities located in the Chesapeake Bay Watershed (from PA, MD, VA, DE, WV, NY and the District of Columbia). These point sources are divided into several categories including:

- Significant Municipal facilities which generally are municipal wastewater treatment plants that discharge flows of equal to or greater than 0.5 MGD. More specifically, significant municipal facilities are defined slightly differently for each jurisdiction. For Virginia, these facilities are those that 1) have a design flow of 0.5 MGD or greater, and 2) are located below the fall line, regardless of flow. For MD, significant facilities are those having a current flow of 0.5 MGD or greater. For PA, significant facilities are those having average annual 1985 flows of 0.4 MGD or greater. For DE, WV and NY the Chesapeake Bay Program selected facilities in the EPA Permit Compliance System database with current flows of 0.5 or greater.

- Significant Industrial facilities which have been identified to discharge equivalent or greater amounts of nutrient as compared to a municipal wastewater treatment of 0.5 MGD. These discharge loads would roughly be equivalent to those of municipalities' with flows of 0.5 MGD or greater, and a Total Nitrogen load of 75 lbs/day, and a Phosphorus load of 25 lbs/day or greater [based on a municipal discharge of 6 mg/l total phosphorus (TP) and 18 mg/l total nitrogen (TN)].

- Non-significant municipal facilities are those which are generally smaller than discharge flows of 0.5 MGD. Only facilities in MD and VA are included in database due to availability of data. While there are approximately 185 non-significant municipal facilities, the flow and corresponding load from these facilities is less than 5% of that from the total for all point sources.

- Combine Sewer Overflows (CSO): only the CSO for the District of Colombia is included in the database because this is the only CSO for which the Bay Program has nutrient load data. Certainly there are other CSOs in the Bay watershed, but to date, these have not been quantified in terms of nitrogen and phosphorus load discharges.

Exhibit 2-12 provides a summary profile of these facilities in the watershed.

Exhibit 2-12: Point Source Summary Profile

Point Source Category	Description	Number of Facilities	Total 2000 Flow (MGD)
Significant Municipals*	Generally > 0.5 MGD	304	1554.4
Significant Industrials	Discharge loads generally > 75 lb/day TN & 25 lb/day TP	49	524.7
Non-significant Municipals	Generally < 0.5 MGD	185	10.8
CSOs	Only for Blue Plains	1	7.6
Total		**540**	**2,097.5**

* Including the six VA plants to be built by 2010.

Today, 83 of the 304 significant municipal wastewater treatment plants , and many industrial facilities as well, are operating Nutrient Removal Technology (NRT). By 2010, that number is likely to increase to 156. Exponential advances in the development of NRT in recent years, along with performance levels beyond what was traditionally expected, have clearly shown the potential for this technology to achieve much lower levels of nitrogen in discharges than the traditionally accepted performance levels. To date, 12 of the 49 significant industrial nutrient dischargers located in the Bay watershed are practicing some form of nutrient removal, and we expect that number to increase to 16 by 2010.

The nutrient load discharged from point sources is directly linked to population. Because of the implementation of NRT to date, these point sources collectively have achieved a 53 % reduction in phosphorus loads and a 28 percent reduction in nitrogen loads since 1985, despite the 15 percent increase in population since then. But because the watershed's population is expected to increase by an additional 14% by 2010, it will be increasingly more challenging to achieve nutrient reductions from point sources. **Exhibit 2-13** illustrates the nitrogen loads from point sources in the past, present and for future projections based on NRT implementation plans by 2010, and for the year 2020 if no more facilities than currently planned implement NRT. **Exhibit 2-14** shows the same for phosphorus loads. As Exhibits 2-13 and 2-14 show, significant progress has been made since 1985 in getting reductions, but population growth will eat away at these successes unless NRT is implemented in more of the facilities, while simultaneously reaching for greater performance levels.

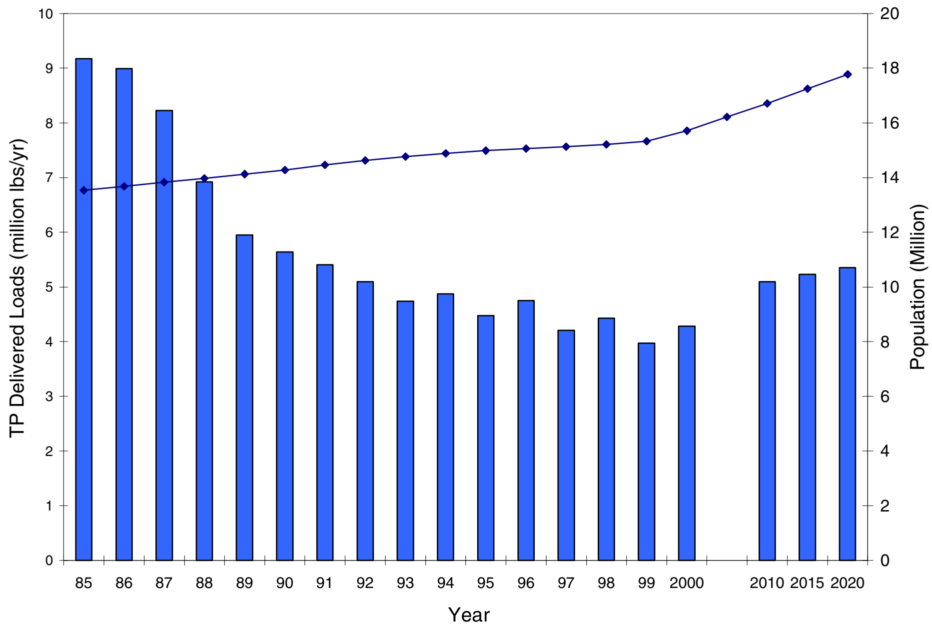


Exhibit 2-13: Total Phosphorus Delivered Loads, from Point Sources and Population

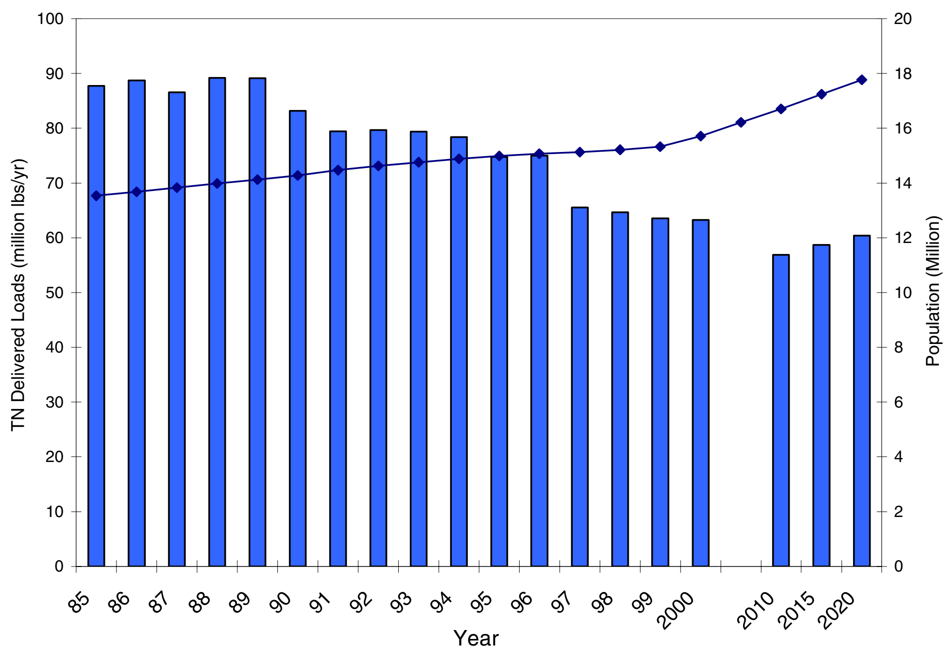


Exhibit 2-14: Total Nitrogen Delivered Loads, from Point Sources and Population